
Marine Physical Laboratory

Downslope Conversion

W. S. Hodgkiss

Supported by the
Chief of Naval Research
Grant N00014-91-J-1237

Final Report

MPL-U-70/95
September 1995

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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
<small>Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.</small>				
1. Agency Use Only (Leave Blank).		2. Report Date. September 1995		3. Report Type and Dates Covered. Final Report
4. Title and Subtitle. Downslope Conversion				5. Funding Numbers. N00014-91-J-1237 Project No. Task No.
6. Author(s). W. S. Hodgkiss				
7. Performing Monitoring Agency Name(s) and Address(es). University of California, San Diego Marine Physical Laboratory Scripps Institution of Oceanography San Diego, California 92152				8. Performing Organization Report Number. MPL-U-70/95
9. Sponsoring/Monitoring Agency Name(s) and Address(es). Chief of Naval Research Department of the Navy 800 North Quincy Street Arlington, VA 22217-5660 Code 3210A				10. Sponsoring/Monitoring Agency Report Number.
11. Supplementary Notes.				
12a. Distribution/Availability Statement. Approved for public release; distribution is unlimited.				12b. Distribution Code.
13. Abstract (Maximum 200 words). Carefully controlled and well-documented measurements of downslope signal propagation were made in an ONR-sponsored experiment in July 1989. Analysis of these data along with range-dependent propagation model predictions shows that both downslope conversion and range-variation of the sound speed structure are important propagation mechanisms coupling coastal shipping traffic noise into the sound channel				
14. Subject Terms. downslope signal propagation, matched field processing, ambiguity surface				15. Number of Pages. 3
				16. Price Code.
17. Security Classification of Report. Unclassified	18. Security Classification of This Page. Unclassified	19. Security Classification of Abstract. Unclassified		20. Limitation of Abstract. None

Downslope Conversion

William S. Hodgkiss

Final Report to the
Office of Naval Research
Grant N00014-91-J-1237
for the Period 10-1-90 - 9-30-93

Abstract

Carefully controlled and well-documented measurements of downslope signal propagation were made in an ONR-sponsored experiment in July 1989. Analysis of these data along with range-dependent propagation model predictions shows that both downslope conversion and range-variation of the sound speed structure are important propagation mechanisms coupling coastal shipping traffic noise into the sound channel

Research Objective

The objective of this project was to study the physics of downslope propagation which has been proposed as one mechanism by which acoustic energy from surface sources (e.g. shipping traffic) gets coupled into the sound channel.

Research Summary

Downslope conversion of noise originating from coastal shipping traffic has been discussed as being a major contributor to the low-angle noise

distribution in the vertical plane (angles close to the horizontal). Another major mechanism discussed in the literature is high-latitude wind noise ducted into the sound channel due to shoaling of the sound axis.

Carefully controlled and well-documented measurements of downslope signal propagation were made in an ONR-sponsored experiment in July 1989. These included source deployments (both stations and tows) made in deep water, on the continental shelf, and along the sloping continental margin. For the purpose of propagation modeling, a substantial amount of environmental data was collected including: (1) both time and range-varying sound speed profiles between source and receiving arrays, (2) bottom topography, and (3) subbottom structure. Acoustic data was recorded on two vertical arrays - one on the edge of the continental slope and one out in deep water.

Analysis of these data along with range-dependent propagation model predictions shows that both downslope conversion and range-variation of the sound speed structure are important propagation mechanisms coupling NE Pacific coastal shipping traffic noise into the sound channel.

For sources within a few hundred km of the deep water array, the vertical arrival structure has little low-angle energy. This observation is explained by a simple application of Snell's law for surface grazing rays in a range-independent environment. Source transmissions over the continental slope yield a substantial low-angle of arrival component at the deep water array which is a manifestation of downslope conversion. Arrival structure similar to the continental slope transmissions also is seen from deep water transmissions not far from the continental slope. This vertical arrival structure can be modeled and is due to the range-variation of the sound speed structure between the deep water array and the continental slope. Thus, both downslope conversion and range-variation of the sound speed structure are important propagation mechanisms. These results are documented in [1-3].

Another area of interest in this work has been the manifestation of downslope converted continental shelf noise sources in the matched-field processor (MFP) ambiguity surface. Matched-field processing takes advantage of the complexity of the signal field observed with a large-aperture array of sensors in a waveguide to provide estimates of both source range and depth. Range-dependent Parabolic Equation (PE) simulations based on the July 1989 data set were carried out to investigate how noise sources outside the range of interest leak into the ambiguity surface through the sidelobe structure of the effective MFP

References

beam (or cell) pattern. These simulations show that shallow sources on the continental slope appear in the MFP ambiguity surface as deep peaks when downslope conversion takes place. These results are documented in [4-5]

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